Wavelength dependent pump-probe measurements

Wide wavelength tunability of OPA:

- possibility of studying a variety of interfaces
- carrier injection threshold
  - electron injection
  - hole injection
- multiphoton processes

These thresholds are clearly related to band offsets + activation barrier for hopping

We first applied these concepts to the well-known Si/SiO₂ system.
Pump intensity dependence of injection rate

PROBE shg (a. u.)

increasing pump intensity

4.2nm Si/SiO₂

PUMP: 663 nm
PROBE: 800nm
Finding the number of photons required in the carrier injection process

1. Take data at various pump intensities
2. Find injection rate through fit to exponential rise to max
3. Fit log(rate) vs. log(intensity)

Assumptions:

\[ \text{Rate} \propto W_{\text{injection}} \times W_{\text{transport}} \times W_{\text{trapping}} \]

\[ W_{\text{injection}} \propto |n| \]

\( n \) is the \# of photons
Band offset determination:
Initial data shows stepwise jumps from 1 to 2 and then from 2 to 3 photon injections

![Graph showing photon injections and energy levels]

- 3 photons
- 2 photons
- 1 photon

Pump photon energy (eV)

- 1.1 eV
- < 4.5 eV
- Literature data: 4.3 eV (SiO$_2$ conduction band – Si valance band)
- 0.1 eV hopping activation barrier for electrons

Si | SiO$_2$